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Variation in methods used to determine national mean DMFT scores for 12-year-old children in European countries

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Aim: The aim of this study was to investigate the methods used to identify national mean DMFT scores for 12-year-old children in all the Member States of the European Union and European Economic Area, and in 11 other European countries. **Methods:** The most recent national mean DMFT scores were accessed from the World Health Organisation Oral Health CAPP and the Council of European Chief Dental Officers databanks. A literature search was then performed to access the reports of the studies that had produced these DMFT scores, cited on these databanks. The reports were then analysed to determine: the year in which the survey/study that produced the score took place, the year the results were published, the geographical area (national, regional or local) covered, the number of children examined, how many examiners took part, how they were trained and calibrated, and the criteria used for the detection of caries. **Results:** Data and information from 43 European countries were accessed. The years when the studies were performed ranged from 1990 to 2014. There were doubts over the representativeness of some samples. A wide range of different methods were used. Examiner training and calibration were very variable both in terms of duration and reported inter and intra-examiner consistency. There were important variations in the criteria employed for the detection of caries. **Conclusions:** These findings support the view that most of current national caries data for DMFT levels in 12-year-old children are not comparable across Europe.

Key words: oral epidemiology, national mean DMFT, 12-year-old children, dental caries prevalence, variability, unreliability

Introduction

Declining trends in caries prevalence of children have been reported for the last two decades in many European countries. However, this trend has not been universal and appears to have been reversed for some age groups in some of the countries of Eastern Europe during the period following the collapse of communism (Downer *et al.*, 2005; Künzel 1996) and especially in countries such as Bosnia and Herzegovina, which have suffered wars (Ivankovic *et al.*, 2003).

Worryingly, major inequalities still exist both within, and between countries, in terms of disease severity and prevalence (Marmot and Bell, 2011, Petersen *et al.*, 2005). Even in the Nordic countries, with an established and comprehensive public oral health service, striking differences are observed by social class (Christensen *et al.*, 2010; Petersen 2008).

Bourgeois *et al.* (1998) have stated that the planning of oral health care services is directly dependent on qualitative and quantitative health information, and that there is therefore a need to have reliable information on any potential changes in oral health trends, to ensure the appropriate and timely planning of services according to need. In this way, epidemiological surveys can improve the monitoring of trends in oral health at a population level, aid policy development, evaluate oral health programmes, assess dental needs and provide visibility for dental issues (Burt, 1997).

The World Health Organisation (WHO) Oral Health “Country/Area Profile Programme” (CAPP), was established in 1995. Under various guises, it has collated survey data on trends in dental caries and is generally considered to be the principal international reference centre for global oral health epidemiology (WHO, 2014a;b).

The fifth edition of Oral Health Surveys: Basic Methods (WHO, 2013) recommended that countries conduct periodic national oral health surveys (every 5 years if possible), by precisely defined age groups. In this context, 12-year-olds are considered particularly important as a target group for assessing the level of dental caries severity among children with permanent teeth. Since 1994, national data for mean national DMFT scores have also been collected by the Council of European Chief Dental Officers (CECDO) as part of a larger data collection exercise for European countries (CECDO, 2014).

It has been suggested that the European national mean DMFT scores which appear on both the WHO and CECDO websites are not comparable and are often out of date (Eaton, 2002). There has been criticism of the use of the DMFT index confined to the dentine lesions-only threshold for measuring dental caries in an era of prevention-focussed dentistry and healthcare (Pitts *et al.*, 2011). It has also been suggested that the currently available European caries data are inadequate for planning the provision of oral health care across Europe on a scientific basis (Patel 2012).

These issues are set against a backdrop of more general data limitations which include:

- A scarcity of data from national studies which are based on a representative sample of the population of the country.
- Limited coverage of populations - the collection of administrative data is sometimes linked to individual characteristics, such as insurance status.
- Data access limitations - data collected by institutions other than national government or national institutes may not always be readily accessible due to confidentiality issues or intellectual property rights issues which can prevent their release. (DG SANCO Task Force on Major and Chronic Diseases Report, 2007)

Against this background, this review aimed to investigate the methods used to identify national mean DMFT scores for 12-year-old children in all the Member States of the European Union (EU) and European Economic Area (EEA) and the following non EU/EEA countries: Albania, Armenia, Belarus, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia, Georgia, Moldova, Russia, Switzerland, Turkey and the Ukraine.

The objectives were:

- to review the relevant websites (i.e. the WHO and CECDO databanks),
- to review the published literature and other sources cited to support the national mean DMFT scores for 12-year-old children at a national level on these websites,
- to analyse the methods used in these studies to assess their consistency.

Methods

The following online databanks were interrogated from June 2014 to April 2015 to identify the most recent national mean DMFT scores for 12-year-olds and the surveys cited as providing these data:

- WHO Oral Health CAPP Database (WHO, 2014a)
- The CECDO database (CECDO, 2014)

DMFT scores and the literature cited to support the most recent surveys in the 11 non-EU/EEA countries listed in the introduction to this paper and all 31 countries of the EU and EEA (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechoslovak Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom (England, Northern Ireland and Wales) plus Scotland, a total of 43 countries, were accessed. Because, for several years, Scotland has reported national data on dental caries separately to the rest of the United Kingdom, for the purposes of the current review, it was considered as a separate country.

In order to check that no studies had been missed a country-specific search of the literature available on MEDLINE/PubMed was undertaken. The following search terms were used: "12-year-olds, survey, dental caries, prevalence" + "COUNTRY" to identify national

surveys only. To ensure that the most recent surveys for each country was identified, no time limit was set, as for some countries "most recent" was found to be over 20 years ago. The MEDLINE/PubMed search revealed no national surveys, over and above those cited on the WHO CAPP and CECDO websites.

Once the relevant papers or reports of the surveys were accessed, the following factors were analysed from each report:

- The mean DMFT score in the last survey of 12-year-olds
- The year that the survey/study took place
- The year that the results of this survey were published
- Source of information (in a journal or a website or an internal report for a Ministry of Health)
- Geographical area covered : was it fully national or in selected regions (e.g. as in WHO pathfinder surveys) or just in one region or local (e.g. just in one city)
- The number of 12-year-old children examined
- How many examiners took part?
- How the examiners were trained and calibrated
- Which criteria for caries diagnosis were used? [WHO (1987 or 1997 or International Caries Detection and Assessment System (ICDAS))]

Where the published literature did not give answers to these questions, the CDO or equivalent of the European country in question was personally contacted with a request to provide information on the methods used to produce national mean DMFT scores for 12-year-olds in their countries.

Results

A summary of the analysis of the methods used in 43 European countries, from the literature search, interrogation of WHO and CECDO databanks, and personal communications with CDOs is available in the online version of this paper (Appendix 1, www.cdjournal.org). Summaries of the findings, under subheadings for the topics listed in the methods section, now follow:

Mean national DMFT score for 12-year-old children and the year that the survey took place

Mean National DMFT Scores for 12-year-olds were available for all 43 countries. However, in five countries the scores were derived from studies that took place prior to 2000. In 21 countries, they had been performed between 2000 and 2009. In the remaining 17 countries, the surveys had been performed in or after 2010. The authors were advised that a national survey of 12-year-olds was currently in progress, in 10 European countries. These results indicate wide variation in the years when the studies were performed.

Year of publication of results and source of information

In 33 countries, results were published within three years of the completion of the survey concerned. In the other ten countries the results were not published in accessible sources for four years or more (range four to nine years) after the survey concerned.

For all 43 countries, national mean DMFT scores for 12-year-olds were available either from the WHO or CECD databases or from both. Details of the surveys concerned for 32 countries were found in English in published papers. For six of the other 11 countries, the CDOs concerned were able to cite websites and/or give details of the methods used. For the remaining five countries details were unobtainable either because they were not in English or because they came from internal Ministry of Health reports.

Geographical area covered

In 32 of the 43 countries the surveys could be classified as “national”. However, within this category some used sophisticated techniques to obtain a representative sample from all parts of the countries concerned, others used the WHO Pathfinder method and in the Scandinavian countries (Denmark, Finland, Norway and Sweden) the national DMFT scores were calculated by consolidating data for 12-year-olds sent annually to the Ministries of Health from Public Dental Services Clinics (Danish National Board of Health, 2013; Widström and Järvinen 2011; Statistics Norway 2014; Swedish National Board of Health and Welfare 2011). In Croatia the “national” DMFT score was derived from a survey in two schools in Zagreb (Dukic *et al.*, 2011) and in Switzerland from a survey in the Canton of Zurich (Steiner *et al.*, 2010). No details of the geographical area covered could be ascertained for the other nine countries (Armenia, Estonia, Former Yugoslav Republic of Macedonia, Hungary, Liechtenstein, Luxemburg, Poland, Romania and Ukraine). However, it is understood that the national surveys undertaken in Hungary and Romania used the WHO (1997) pathfinder method but it was impossible to access either published papers or Government reports to confirm this.

Number of 12-year-olds examined

Large differences in survey sample sizes were evident. A total of 19 of the national surveys had stated sample sizes greater than 1,000 and two of fewer than 300. There was also wide variation in the ratio of sample size to national population. For example in Austria, with a total population of just over eight million, 3,504 12-year-olds were examined, while in Spain with a total population of 46.5 million only 573 were examined.

How many examiners took part?

Details of the numbers of examiners were given in the reports from 29 countries. They ranged from one in smaller countries to 100 in Russia. In the four Scandinavian countries all dentists who examined 12-year-olds contributed to the national data and in the reports from the remaining 10 countries this information was not provided.

How were the examiners trained and calibrated?

In reports from 31 countries details of examiner training and calibration were provided. This information was not provided for 12 countries, four of which were Denmark, Finland, Norway and Sweden. Reported length of training varied substantially from one day in France to one month in Moldova. A Kappa statistic for intra and inter-

examiner consistency was quoted in reports from only 13 countries. For inter-examiner consistency it ranged from 0.67 to 0.97. Degree of inter-examiner agreement was mentioned in reports from two further countries.

Although many of the reports reviewed mentioned that examiner training and calibration, was undertaken according to WHO guidelines, when details were given, there appeared to be wide variations between surveys.

Which criteria were used for caries diagnosis?

Where details of the method were provided for a national survey, the WHO Oral Health Surveys - Basic Methods, 4th Edition (1997) criteria for caries diagnosis were reported as being employed in 19 surveys while five surveys used WHO (1987) criteria (all of these used dentine cavitation as the detection threshold.) Three surveys used BASCD criteria (Pitts *et al.*, 1997) - employing the dentinal shadow threshold for caries; and four used ICDAS, which collects data at the enamel + dentine threshold. The 2013 Survey in England, Wales and Northern Ireland used and reported on criteria at both the enamel + dentine and the dentinal shadow thresholds. No indication of the criteria for diagnosis of caries was found in reports from 12 countries, four of which were Denmark, Finland, Norway and Sweden (although in Denmark it has now been made clear that data are recorded and available at both the enamel + dentine and the dentine only thresholds).

Discussion

Mean national DMFT scores for 12-year-olds were selected as the indicator against which to judge the adequacy of current systems for assessing caries prevalence in 12-year-olds and for providing European comparisons. This was because a review of the WHO databank revealed that more European countries collected data for this age group than for any other age groups (WHO CAPP Databank, 2014a).

The criteria against which the surveys reviewed in this study could have included others such as how consent was obtained as it has been suggested (Monaghan *et al.*, 2011) that the parents of children with several carious teeth are less likely to consent to them being examined, thus leading to under-reporting of caries prevalence in a population. However, the method used to obtain consent was not specified in many of the reports that were reviewed and so this criterion was not included in the current study.

It was surprising to find such a wide variation in dates when the last national surveys of 12-year-olds were performed. All of the five countries in which studies were last performed prior to 2000 were small, with populations of under 4.5 million. However, at the time of this investigation only 10 of the 43 countries had performed national surveys in the last five years. A further 10 countries reported either that they were conducting or were about to start national surveys. Nevertheless, because they are not contemporaneous it is unwise to make inter-country comparisons for all 43 countries when there is such variation in the dates of the studies.

There were also wide variations in terms of sampling

technique, criteria used for the detection of caries, and training and calibration of examiners. Such differences limit the reliability and comparability of resulting caries data. That said, the representativeness of any sample is also linked to the sample size, and small samples such as 573 from relatively heavily populated countries such as Spain (Llodra Calvo *et al.*, 2012), jeopardise the value of any comparisons between regions within a country.

Historically, the potential problems in applying the recommendations for sampling within the WHO Pathfinder method were clearly demonstrated by two national surveys that took place in Portugal in 1999. The resulting unrepresentative sample produced a figure for mean national DMFT score for 12 year olds of 1.5 (Almeida *et al.*, 2000). In the same year, a second national survey in Portugal found a national mean DMFT score for 12-year-olds of 3.08 (General Directorate of Health, 2000).

The lack of dedicated surveys using DMFT scores in children in the Nordic countries has been justified by the high proportion of children, especially 12-year-olds who attend public dental clinics for annual examination, on the principle that there is no need to seek a representative sample if the vast majority are attending (von der Fehr, 1994). This approach can be challenged on the grounds that the small percentage of non-attendees may well have a significantly higher level of caries than the mean for the attendees, and that their non-inclusion biases the resulting data. For example, the percentage of 12-year-olds examined in Norway, varied between 62 and 91% from county to county, (Statistics Norway, 2014). This contention can also be supported by the fact that in Scotland there is evidence that those most at risk from dental caries were least likely to be registered for care within the General Dental Services of the NHS (Pitts *et al.*, 1994).

Both the BASCD guidelines (Pine *et al.*, 1997b) and those of the WHO (1997) set out guidelines for the training and calibration of examiners and suggest that this might take from two to five days. The training and calibration techniques of examiners in the surveys varied substantially, with wide variation in its length from one day in France (Hescot and Roland, 2006) to one month in Moldova (Lupan *et al.*, 2012). A variety of training methods were utilised including the use of web learning (via ICDAS software in Austria), practical training on “real” patients and simulated training using clinical photographs displayed via Powerpoint (Belgium). The numbers of examiners also varied, from one in Cyprus, to 100 in Russia, again reflecting to some extent, differences in sample sizes and methods. There were also differences in the levels of clinical experience of the examiners, for example in Turkey, fourth and fifth year dental students served as examiners, where all 27 examiners had good inter-examiner consistency, but were not checked for intra-examiner reliability. The estimated inter-examiner Kappa score was >0.80 (Gökalp *et al.*, 2010). Whereas in Germany, public health dentists performed the examinations, nearly all of whom had participated in previous cross-sectional investigations. Their inter-examiner Kappa score was 0.85 (Pieper *et al.*, 2013).

In studies in Finland, it has been argued that assessments of oral health made by PDS dentists and trained epidemiologists are satisfactorily similar (Hausen *et al.*,

2001). However, von der Fehr (1994) has suggested that in Sweden there have been historical variations between counties and municipalities in applying diagnostic criteria, and Bille and Carstens (1989) and Gimmestad (1992) reported that dentinal caries has been overlooked on some occasions and by some clinicians.

These variations cast further doubts as to the reliability of the data arising from some of the surveys reviewed and reinforce the view that it is currently unreasonable to compare the results of many of the surveys. There is therefore a need for international collaboration to agree and implement a new standardised method for the assessment of the prevalence of dental caries and to use this method in all future national surveys. Such collaboration could be fostered by holding frequent international training and calibration sessions of the type held in Dundee in 2000 (Pitts *et al.*, 2000), by involving all national and international associations concerned with Dental Public Health and by encouraging the presence of external monitors/auditors from other countries during national surveys. This would need to be complemented by the construction of a database with standardised data at a national and European level, which facilitated the continual assessment of validity.

In conclusion, from this investigation of the methods employed in the studies that had generated the national data for DMFT scores for 12-year-olds listed in the WHO and CECDO databanks. It was apparent that a range of different diagnostic criteria, sampling techniques and methods to train and calibrate examiners have been employed. These findings support the view that most of the current national data for DMFT scores in 12-year-old children are not comparable across Europe. There is thus a need to achieve a European consensus on quality standards for measuring, collecting, reporting and evaluating caries epidemiological data. This is fundamental in order to achieve a reliable European data and knowledge base which could subsequently be used in monitoring caries prevalence, and helping to implement caries preventive programmes in Europe.

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